(No Model.) 3 Sheets—Sheet 1.

T. A. EDISON.

PHONOGRAPH.

No. 386,974. Patented July 31, 1888.

Fig. 1.

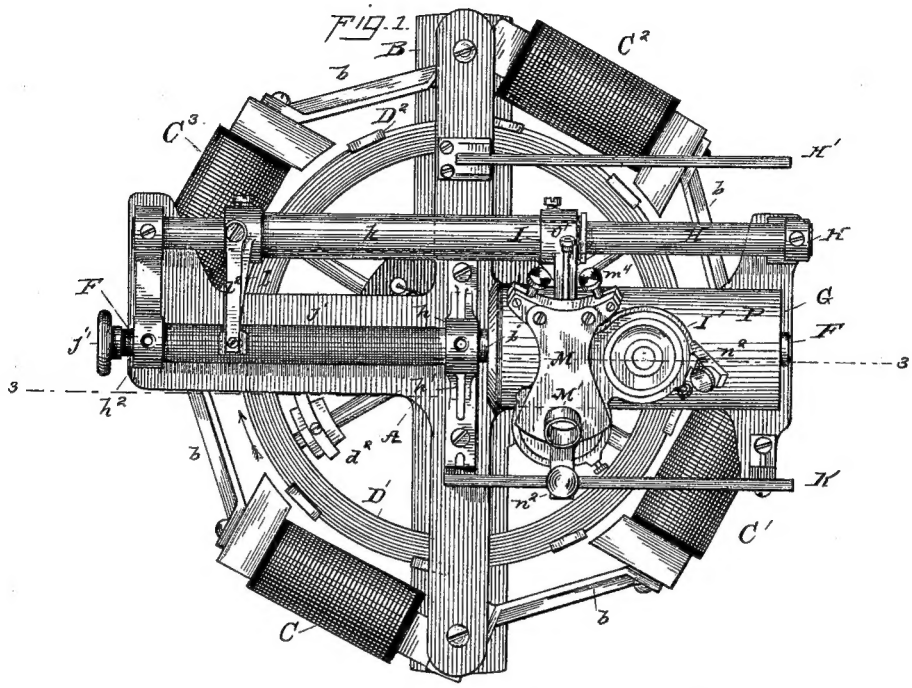
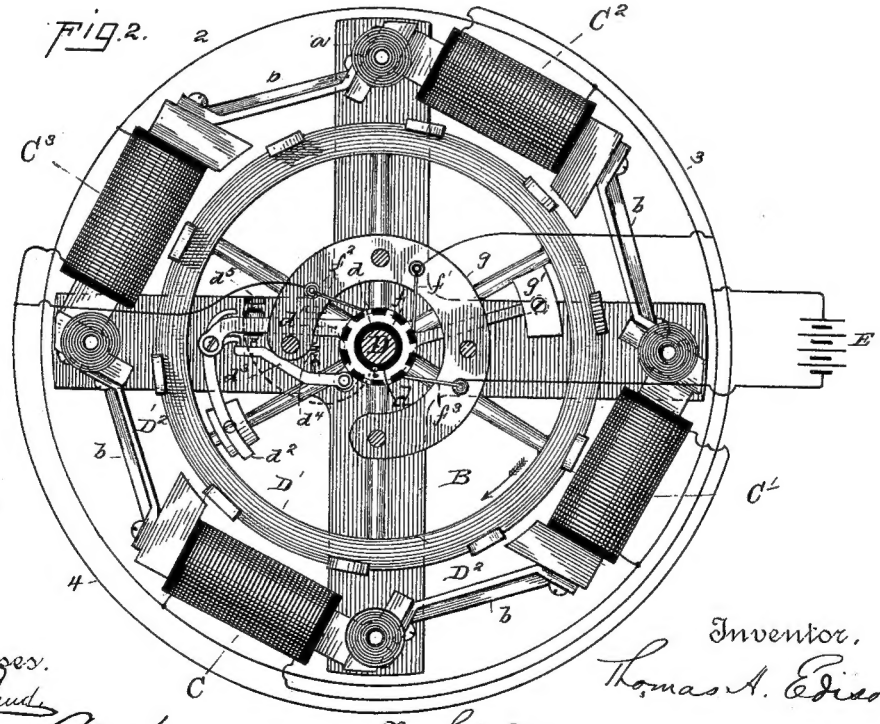


Fig. 2.



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(No Model.) 3 Sheets—Sheet 2.

T. A. EDISON.

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Fig. 3.

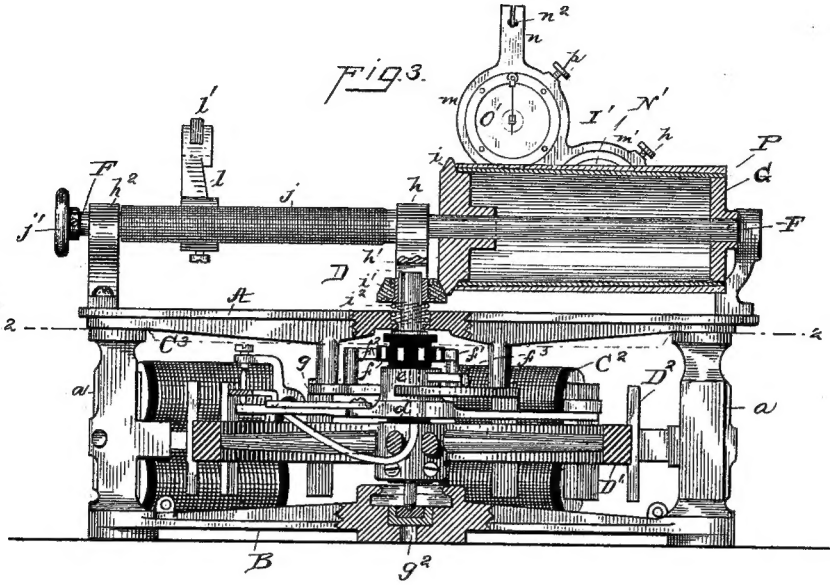
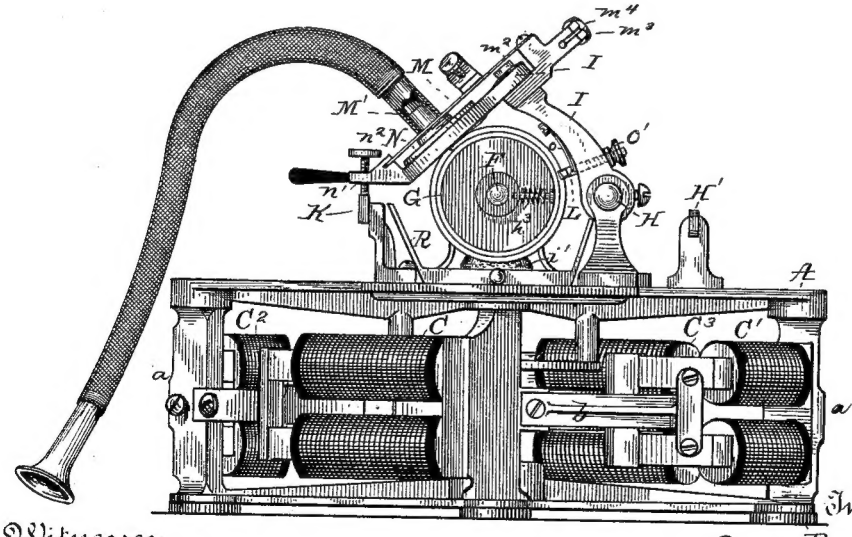


Fig. 4.



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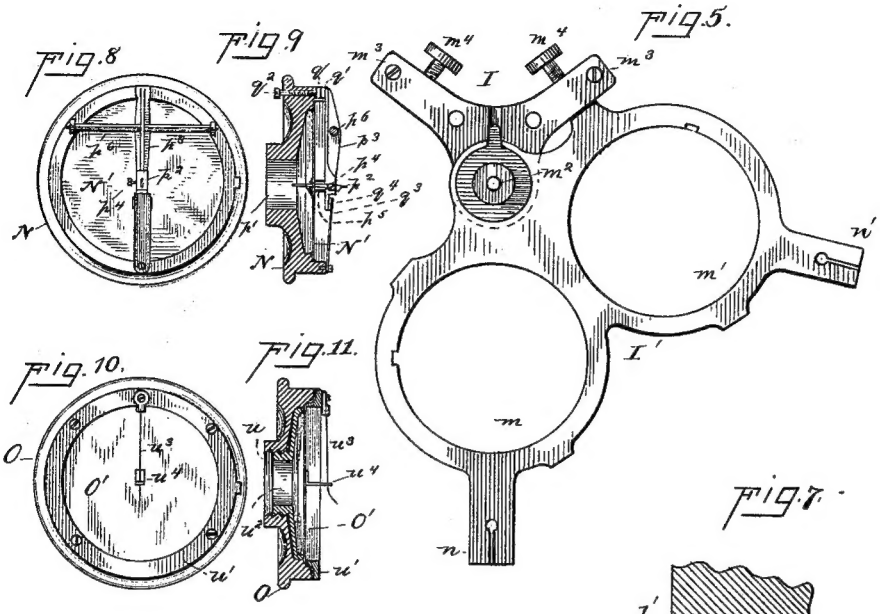
(No Model.) 3 Sheets—Sheet 3.

T. A. EDISON.

PHONOGRAPH.

No. 386,974. Patented July 31, 1888.



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UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, NEW JERSEY.

PHONOGRAPH.

SPECIFICATION forming part of Letters Patent No. 386,974, dated July 31, 1888.

Application filed November 26, 1887. Serial No. 256,189. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Phonographs, (Case No. 741,) of which the following is a specification.

The object I have in view is, generally, to so improve the phonograph that it will be well adapted for use by the public and will be a convenient and efficient machine for various uses.

In the accompanying drawings, forming a part hereof, Figure 1 is a top view of the machine; Fig. 2, a horizontal section on the line 2 2 in Fig. 3, with a diagram of the motor connections; Fig. 3, a vertical section on the line 3 3 in Fig. 1, with the swinging holder and guide-arm thrown back; Fig. 4, an elevation of the machine looking at the end of the phonogram-cylinder; Fig. 5, top view of the swinging holder carrying the recorder and reproducer; Fig. 6, a side elevation of the guide-arm; Fig. 7, a sectional view, on an enlarged scale, showing the engagement of the spring guide-block with the lead-screw; Figs. 8 and 9, a bottom view and central section, respectively, of the recorder; Figs. 10 and 11, a bottom view and central section, respectively, of the reproducer; Fig. 12, an elevation of the guide-rest; Fig. 13, a sectional view of a phonogram-blank showing by dotted lines its division into sections, and Fig. 14 an elevation showing the four different sizes of the phonogram-blank.

Like letters denote corresponding parts in all the figures.

The frame of the machine is constructed, for convenience, of a top and a bottom plate, A B, each constructed as a spider composed of four arms, the ends of the arms of the two frames being joined by vertical posts *a*. To these posts are connected the yokes of four magnets, C C′ C² C³, each projecting from the post to which it is attached toward the adjoining post, to which its pole-pieces are connected by braces *b* of brass or other non-magnetic metal. The poles of the four magnets project inwardly, as shown, and are cut with concave faces, the poles of all four magnets being in the line of a circle. Within this circle and mounted upon a vertical shaft, D, is a fly-wheel, D′, constructed of brass and having a heavy rim so as to increase its weight. Upon the periphery of the rim of the fly-wheel are secured a number of armatures, D², of iron, which are placed vertically, equal distances apart, and travel in their movement close to the pole-pieces of the magnets C, C′, C², and C³. Upon the shaft D, above the wheel D′, is mounted a sleeve, *d*, of insulating material, upon which is secured a metal collar, *e*, and above this collar a commutator, *f*, the commutator being composed of a ring of metal having its surface broken by blocks of insulating material, so that it presents alternate spaces of insulation and metal in a manner well understood. From the collar *e* projects an arm, *d′*, in a radial direction, and upon the end of this arm is pivoted a swinging weight-arm, *d²*, which, by its outward movement, moves a lever, *d³*, which is held against its movement by an adjustable spring, *d⁴*. The lever *d³* bears normally upon the insulated contact-screw *d⁵*, which is connected by a wire with the base of the commutator *f*.

The magnets C C′ C² C³ have one end of their windings connected together by a wire, 2. The other end of the windings of the two opposite magnets C and C² are connected together by a wire, 3, while the other ends of the windings of the opposite magnets C′ and C³ are connected together by a wire, 4. The wires 3 and 4 are connected with two springs, *f′* and *f²*, which bear upon the face of the commutator *f*. A spring, *f³*, bears directly upon the collar *e*. These three springs are supported by a circular piece of insulation, *g*, which is supported above the wheel D′ and below the top plate by means of posts extending down from the top plate.

One pole of the battery E which drives the motor is connected with the wire 2, which joins one end of the windings of all the magnets, while the other pole of the battery is connected with the spring *f³*, bearing upon the collar *e*. The parts are arranged so that the wheel D′ will be turned by the magnets always in the direction shown by the arrow in the drawings.

The magnets C and C² first receive the current and attract two armatures upon the wheel, and then the magnets C′ and C³ receive the current and attract two armatures upon

the wheel, the current being transferred from one pair of magnets to another in succession, so that the wheel is given a continuous rotary movement. An excess of battery-power is preferably used, and the speed of the wheel controlled by the governor, formed by the spring-retracted arms d^2 and d^3. This governor opens the circuit when the speed exceeds the normal, so that within limits of variation which are so small as to be practically of no effect in the operation of the machine the speed will be kept uniform. By the adjustment of the spring d^4 the governor can be made to work at any desired point. By the use of an electro-magnetic motor of this description—namely, one composed of a heavy fly-wheel carrying armatures on its periphery, which are attracted by magnets arranged in a circle around the fly-wheel—a slow and uniform motion can be obtained, which is a matter of the highest importance in the operation of the phonograph, and tends to simplify the construction, since the complication introduced by the employment of a number of speed-reducing wheels is avoided. Projecting from the collar *e* on the opposite side to the governor is an arm, g', carrying a weight at its end for counterbalancing the weight of the governor, so that the wheel may be a balanced one. The shaft D is stepped on a jewel, g^2, at the center of the bottom plate, A, giving freedom of movement to the wheel and reducing the noise of friction to the minimum, so as to not affect materially the operation of the phonograph.

Upon the top plate, A, is journaled the horizontal shaft F, this shaft being carried by a journal-box, *h*, in the top of an arched standard, h', at the center of the top plate, and at one end by a journal-box, h^2, at the end of one of the arms of the top plate. Between the bearings *h* and h^2 the shaft F is larger than it is outside of such bearings, so that it bears against the inner faces of the bearings by shoulders which prevent any longitudinal movement of the shaft. The shaft F projects beyond the bearing *h* to the opposite side of the machine from the bearing h^2, but is not supported at its end, it being free to receive the phonogram-cylinder G, which is slipped upon this shaft, preferably removably, and held by a spring-pin, h^3, taking into a hole in the end of the shaft. This phonogram-cylinder is made hollow, of brass or other suitable metal, its heads bearing upon the shaft, so as to center the cylinder properly. The cylinder is made slightly tapering, for a purpose which will be presently explained, its inner end—that next to the bearing *h*—being somewhat larger than its outer end. The inner end of the phonogram-cylinder is constructed as a beveled friction-wheel, *i*, upon which bears a beveled pinion, i', of some suitable soft material. This pinion i' is mounted upon the upper end of the shaft D, which projects through the top plate into the space between the legs of the arched standard h'. The pinion i' may be provided with an operative face, of leather or other similar material, mounted upon a metal hub. This metal hub is preferably constructed to slide vertically upon the shaft D, it being prevented from turning thereon by a suitable key, and beneath the pinion is a spiral spring, i^2, which forces the pinion upwardly and keeps it solidly against the beveled wheel on the inner end of the phonogram-cylinder, so that the wear of the surfaces is taken up and the pinion is kept in firm contact. By the use of this beveled friction-gearing, of which the soft-surfaced pinion is a part, I am enabled to change the motion from the vertical shaft of the motor to the horizontal shaft of the phonogram-cylinder without the production of noise, which would be detrimental to the operation of the instrument.

The horizontal arrangement of the motor permits a large fly-wheel to be used, while the compactness of the instrument is maintained. Between the bearings *h* and h^2 the shaft F is cut with an exceedingly fine screw-thread, *j*, of the peculiar construction which will be explained farther on, while outside of the bearing h^2 the shaft is provided with a hand-wheel, j', by which it can be held when it is desired to remove the phonogram-cylinder from the shaft or remove the phonogram-blank or phonogram from the phonogram-cylinder without taking the latter off of the shaft.

Parallel with the shaft F, and located in the rear of the same, is a guide-rod, H, mounted in suitable supports at its ends and extending entirely across the machine. Upon this guide-rod is an accurately-fitting tube, *k*, which is of such length that it can be moved upon the rod between the supports at the end of the rod a distance equal to the length of the phonogram-cylinder. Upon the end of this tube next to the phonogram-cylinder is secured the holding-arm, which carries the recorder and reproducer, while at the opposite end of this tube is the guide-arm, which engages with the lead-screw *j*. The guide-arm is a rigid arm, *l*, having a hub which slips on the tube *k*, and is secured thereto by a set-screw. This guide-arm projects toward the shaft F, terminating at its free end above the screw-thread *j*. The end of the arm *l* is slotted, so as to form two guide-cheeks, between which plays a vertically-sliding block, l'. This block l' bears upon the screw-thread *j*, and is cut with a section of the corresponding thread. A spring, l^2, extends along the top of the arm *l*, and is secured to the block l', forcing such block downwardly upon the screw-thread, so that a rocking movement of the tube *k* can be made within certain limits without disengaging the block l' from the screw-thread *j*. The screw-thread *j* and the thread upon the block l' are cut as fine as it is possible to make a screw-thread having the desired wearing capacity. I make this screw-thread, preferably, with about one hundred threads to the inch, and in order to make such a fine thread do the work required of it without danger of the guide-arm

being forced back, I construct these threads as a ratchet, as shown in Fig. 7, the engaging sides of the threads being straight and the other sides beveled, so that the danger of slipping backward is entirely obviated. Upon the other end of the tube *k* is secured the arm I by means of a set-screw, such arm projecting forward over the center of the phonogram-cylinder. Upon the upper end of this arm I is pivoted the holding-frame I′, placed nearly at right angles to the arm I, and made, similar to the frame of spectacles, with two eyes, *m m′*. The pivoting-screw m^2 for this frame passes through the frame at one side and centrally between the eyes *m m′*, the nut for securing the frame bearing upon the spring-washer beneath it, so that the frame will hold itself at either limit of its throw and will not be jarred from position.

The arm I has two horns, m^3, through which the set-screws m^4 pass for limiting the movement of the frame I′ and for adjusting the point at which the frame will be stopped when swung in either direction, so as to bring its holding eyes in the correct relation to the phonogram-cylinder. These holding-eyes carry the recorder and reproducer, the construction of which will be presently explained, and the object of the swinging frame is to permit either the recorder or reproducer to be brought into operative relation with the phonogram-cylinder.

The screws m^4, bearing upon the swinging frame I′, form a means for adjusting such frame and the recorder or reproducer carried by it laterally with respect to the spiral line of record upon the surface of the phonogram-blank. This adjustment is a matter of especial importance so far as the reproducer is concerned. The recorder produces the record, and hence makes its own track; but the reproducer must follow that track. It has been proposed to mount the reproducing-point in such a flexible manner that it will follow the track made by the recorder without adjustment; but I have found that the lateral adjustment of the reproducer enables me to bring its point readily into the track of the record, and to give it the proper relation to the record for producing the maximum effects. The adjustment is made while the operator has his ear to the listening-tube, the character of the reproduced sounds determining when the proper adjustment is reached.

The eyes *m m′* have fingers *n n′*, which project forward and have passing through them adjusting screws n^2, which rest as each eye is brought into position for operation upon a guide-rest, K, which extends parallel to the shaft F in front of the phonogram-cylinder and supports the holding-frame at the required elevation to bring the recorder or reproducer into accurate adjustment. The fingers *n n′* have small handles attached to them, as shown in Fig. 4, by which the swinging holding frame can be more conveniently manipulated. Back of the guide-rod H there is another rest, H′, to receive the arm I when it is thrown back. This rest is preferably more or less springy in its character, so as not to jar the parts injuriously when the arm is thrown back upon it. Passing through the arm I near the tube *k* is the shank of a cutting-tool, L, which is thrown forward by a spring, *o*, on the inner side of the arm and is retracted by a thumb-nut, *o′*, on the screw-threaded end of the shank outside of the arm. This cutter L is designed to turn off the surface of the phonogram or phonogram-blank, so as to make it true for recording, or to turn off one record and leave the surface ready for another record. This enables one phonogram-blank to be used over and over again for recording and reproducing, the recorder and reproducer being brought into operative relation with the clear surface, as the diameter of the phonogram-blank is decreased, by the adjustment of the screws n^2, the yielding guide-block *l′* permitting this to be done.

Upon the arm I, above the swinging holding-frame for the recorder and reproducer, is secured a carrying-plate, M, to which is connected a tube, M′. This tube serves as the mouth and ear piece of the instrument, or it may have mouth and ear pieces removably attached to it. The plate M is stationary, and the holding-eyes are swung under it alternately, so that one tube answers both for recording and reproducing, thus adding to the simplicity of the instrument.

The recorder N is a circular plate, which fits either eye, *m* or *m′*, of the carrying-frame, it being provided with a rib engaging with a groove in the eye, so that it will always have the same position in the eye. It is shown as held by the eye *m′*. A set-screw, *p*, is used for holding the plate in the eye. This plate N has an opening, *p′*, through it, which is brought into line with the tube M′ when the eye *m′* is swung into position for the operation of the recorder. The back of the plate N is recessed to form a circular chamber, on a shoulder in which is placed the diaphragm N′, which is preferably made of celluloid or some other light material, and is placed in the recess at the back of the plate N, but is left free at its edges. The recording-point p^2 is secured to the center of the diaphragm by wax or in any other suitable way. This point is constructed of a thin plate of steel, which is cut or ground to a point on one edge and is beveled backwardly away from that edge, so as to give a support for the indenting-point and prevent vibration of that point in operation. This point passes through the end of the lever p^3, and is secured therein by a set-screw, p^4, the point being surrounded between the lever and the diaphragm by a small tube, p^5, of rubber or other suitable material. The lever p^3 is rigid in its construction, and is mounted upon a cross-pin, p^6, of considerable length, which is journaled at its ends at the sides of the plate N. The lever p^3 extends beyond the pivoting-pin p^6 and rests at its outer end against a block, *q*, which is faced with a piece

of pure india-rubber, q'. This block is set in a recess in the edge of the plate N, and is adjusted forward by a screw, q^2. The adjustable block q and its elastic face q' form a yielding limiting-stop for the movement of the indenting-point. The other end of the lever p^3 extends beyond the indenting-point p^2 and receives inward pressure from a spring, q^3, which is secured to the rim of the plate N, opposite to the block q, and presses the lever p^3 and the indenting-point inwardly, so as to give the center of the diaphragm a slight inward bend, producing an initial strain upon the diaphragm. Between the end of the spring q^3 and the lever p^3 a piece of india-rubber, q^4, is placed. The lever p^3, being rigid in its construction and in its support by the long bearing, prevents any vibration of the indenting-point, while the adjustable limit-stop formed by the block q and rubber q' limit the movement of the diaphragm to a small compass. This construction of recorder I have found exceedingly effective in use. The diaphragm is highly sensitive and responds accurately to speech vibrations. The movement of the indenting-point is quite free within exceedingly small limits; but the resistance to its movement increases enormously as the extent of the movement is increased; hence the importance of the fundamental tones in the operation of the instrument is reduced, while the hissing tones which produce movements of a small extent are given an undue importance in the record. This makes the reproduced sound clear and intelligible, since the hissing sounds are brought out clearly and can be distinguished from the scraping noises of the instrument.

It will be observed that the diaphragm is under constant tension and can have no movement at all except that which is permitted by the elasticity of the yielding limit-stop q'. Heretofore the diaphragm of the phonograph-recorder and the indenting-point have not been limited in their forward movement, except by the capacity of the diaphragm for vibration. This has permitted strong waves, owing to great momentum and the small amount of energy stored up as a retracting-force, to give abnormal and untruthful vibrations to the diaphragm. With my present recorder the diaphragm does not force the lever forward into space, but compresses matter always in contact—viz., the rubber q'; hence nearly all the work is stored up in the compression of q' to effect the return movement, and momentum becoming a small factor compared to the power stored up, the diaphragm is not given untruthful vibrations. This principle of construction of the recorder I have termed a "closed" or "constrained" system of movement as distinguished from the open or free system of movement heretofore employed.

I do not claim herein the peculiar recorder *per se*, since it is made the subject of a separate application for patent filed March 2, 1888, Serial No. 265,887.

The reproducer which I employ is also an improved instrument of great effectiveness. It has a plate, O, similar to the plate N, which is held removably in the eye m' in the same way that the plate N is held in the eye m'. This plate O has an opening, u, through it, which is brought into line with the tube M, for bringing the reproducer into operative relation with the phonogram-cylinder. The plate O is recessed at its back and has stretched across it a diaphragm, O', which is preferably a thin animal membrane. This diaphragm is secured in place by a ring, u', which is secured to the back of the plate O, while the diaphragm is stretched by another ring, u^2, which has a neck screwing into the opening u of the plate, and is capable of being turned by a tool, so as to stretch the diaphragm O' more or less. To one edge of the ring u' is secured a fine spring-wire, u^3, which is long enough to reach from the point where it is secured to the center of the diaphragm, and has its inner end turned downwardly, as shown, to follow the spiral line of indentations upon the phonogram. The inner end of this spring-wire u^3 is attached to the center of the diaphragm by a strip, u^4, of rubber. The tendency of the spring-wire is to bend away from the diaphragm, so that it strains the small rubber strip u^4 and places the diaphragm under an initial tension. The movement of the point of the wire u^3 in reproducing is so slight that the strain is never wholly removed from the rubber strip u^4, and hence the diaphragm is always under tension, which tends to draw it outwardly at the center. This makes the instrument exceedingly sensitive and capable of reproducing sounds accurately. The end of the wire u^3 being rounded and burnished, it will not obliterate the phonogram-record, even though that record is made in quite soft material.

I have found that by connecting the reproducing-point with the diaphragm by a strip of elastic material—such as rubber held under tension—the proper wave motion is transmitted to the diaphragm, but the scratching noises, which seem to require molecular transmission, are largely obliterated.

I do not claim herein the peculiar reproducer *per se*, since this is made the subject of a separate application for patent filed March 2, 1888, Serial No. 265,888.

The indenting-point of the recorder has an appreciable width, while the reproducing-point of the reproducer is much finer; hence the track of indentations on the phonogram will be much wider than the reproducing-point and the adjustment of the reproducing-point laterally with respect to the indented track need not be extremely accurate. Should the reproducing-point be found to rest only on the edge of the indented track—which will be indicated by imperfect reproduction—the adjustment of one of the screws m^4 while the listening-tube is held to the ear will cause the spectacles to be adjusted so as to bring the reproducing-point sufficiently into the in-

dented track to give the required clearness of reproduction.

It will be observed that both the recorder and reproducer are complete instruments, each in itself, held by a plate readily removable from the machine. This enables these instruments, which are delicate parts of the apparatus, to be readily removed from the machine for repairs, adjustment, or replacement by other similar parts. As has been previously stated, the phonogram-cylinder is slightly tapering. This is also true of the bore of the phonogram-blanks P, which are constructed of a cylinder, *r*, of some hard material and covered with a recording-surface, *s*, of wax or a wax-like substance. The recording-surface *s* is a true cylinder, while, as before stated, the internal bore of the cylinder *r* is tapering to fit the phonogram-cylinder, so that the phonogram-blank can be pushed upon the cylinder and will be held thereon by friction. I propose to make these phonogram-blanks the entire length of the phonogram-cylinder and also to divide such full-length phonogram-blanks into parts, so that sectional phonogram-blanks will be produced, which will be, for illustration, one-fourth, one-half, and three-fourths the length of the full-sized phonogram-blank. All of these sectional phonogram-blanks as well as the full-sized phonogram-blank will have the tapering bore, so that they can be pushed upon the tapering phonogram-cylinder until they bind and the instrument can then be adjusted to them for recording and reproducing.

I do not claim herein a phonogram-blank or phonogram having a recording-surface of wax or a wax-like material, nor such a device when the wax surface is mounted on a backing of tougher material, such features being claimed in my application No. 734, Serial No. 252,964. Neither do I claim herein a phonogram-blank or phonogram having a tapering bore, or such a bore and a cylindrical recording-surface, since these latter features are set forth and claimed in my Patent No. 382,418, dated May 8, 1888.

By having the phonogram-cylinder mounted upon the shaft F outside of the bearing *h* the phonogram-blanks can be slipped onto and off of the cylinder without disturbing any part of the machine. Upon the guide-rest K, I mark a graduated scale, *t*, by which I can set the reproducing-instrument for reproducing from any part of the phonogram.

A phonogram may have upon its surface the record of two or more letters or other papers or memoranda, and a note may be filed with the phonogram stating between what numbers on the scale *t* each letter or memorandum is recorded on the phonogram. This will enable the instrument to be set for reproducing the exact letter or memorandum by adjustment with reference to the scale *t*. As shown in Fig. 4, a pan, R, may be slipped under the phonogram-cylinder G upon the frame A, for receiving the shavings from the phonogram or phonogram-blank when the cutter L is being used.

For the control of the instrument it is only necessary that a proper circuit-breaker should be placed in the circuit between the battery and the motor, so that the motor can be stopped and started at will. It will be observed that by raising the recorder or reproducer off of the phonogram-cylinder the yielding guide-block *l'*, which takes into the lead-screw *j*, will also be raised out of engagement with the lead-screw, and, although the phonogram-cylinder continues to turn, the recorder or reproducer is not advanced. This enables an operator of the instrument to set the instrument back any distance he may desire to reproduce over again any portion of the matter which he has misunderstood or desires to have repeated.

What I claim as my invention is—

1. In a phonograph, the combination, with the revolving phonogram-carrying shaft and phonogram-cylinder adapted to carry a removable phonogram-blank, of an electric motor having a heavy fly-wheel, armatures carried by such fly-wheel, electro-magnets attracting such armatures, and a commutator, substantially as set forth.

2. In a phonograph, the combination, with the horizontal shaft carrying the phonogram, of a vertical shaft, an electro-magnetic motor mounted upon such vertical shaft, and a beveled friction-gearing transmitting the motion from the vertical shaft to the horizontal shaft, substantially as set forth.

3. In a phonograph, the combination, with the vertical shaft carrying the balance-wheel, electro-magnetic motor, and stepped in a jewel-bearing, of the horizontal phonogram-carrying shaft, and the beveled friction-gearing having one wheel of soft material, substantially as set forth.

4. In a phonograph, the combination of the electro-magnetic motor, consisting of a heavy fly-wheel carrying armatures on its periphery, magnets attracting such armatures, and a commutator with a centrifugal governor controlling the electric circuit of the motor and maintaining a uniform speed of such motor, and a phonogram-carrying shaft connected with the motor by friction-gearing, substantially as set forth.

5. The combination, with the vertical motor-shaft, of the horizontal phonogram-shaft carrying a beveled friction-wheel, and a beveled friction-pinion of soft material mounted on the motor-shaft and pressed against the wheel on the phonogram-shaft by a spring, substantially as set forth.

6. In a phonograph, the combination, with a phonogram-cylinder and advancing screw-thread, of a swinging frame carrying together the separate recorder and reproducer and adapted to bring either into position for operation by the swinging of the frame, substantially as set forth.

7. In a phonograph, the combination, with

the revolving recording-surface, of a swinging spectacle-frame carrying the recorder and reproducer and adapted to be swung so as to bring either into operative relation with the surface, substantially as set forth.

8. In a phonograph, the combination, with a revolving recording-surface, of a swinging frame carrying the recorder and reproducer, and a stationary plate carrying the single speaking or listening tube, the swinging of the frame bringing either the recorder or reproducer into operative relation with the surface and with the speaking or listening tube, substantially as set forth.

9. In a phonograph, the combination, with a revolving phonogram-cylinder, an arm having a movement parallel with the axis of said cylinder, and the reproducer carried by a frame mounted on such arm and adjustable laterally thereon, whereby the reproducer can be readily adjusted to the record, substantially as set forth.

10. In a phonograph, the reproducer carried by a pivoted frame swinging across the lines of record, and an adjusting-screw for determining the lateral position of the reproducer, substantially as set forth.

11. In a phonograph, the combination, with the revolving phonogram-cylinder, of the holding-arm mounted to swing toward and away from the surface of said cylinder, and the reproducer mounted on such arm and laterally adjustable thereon, substantially as set forth.

12. In a phonograph, the combination, with the revolving phonogram-cylinder, of the holding-arm mounted to swing toward and away from the surface of such cylinder, the reproducer mounted on such arm and laterally adjustable thereon, an adjusting-screw for determining the position of the holding-arm relative to the phonogram-cylinder, and an adjusting-screw for determining the lateral position of the reproducer, substantially as set forth.

13. In a phonograph, the combination, with the revolving phonogram-cylinder, of the advancing holding-arm carrying the recorder or reproducer, and a stationary guide-rest for supporting the holding-arm in proper relation with the phonogram-cylinder, substantially as set forth.

14. In a phonograph, the combination, with the revolving phonogram-cylinder, of the advancing holding-arm carrying the recorder or reproducer, a stationary guide-rest for supporting the holding-arm in proper relation with the phonogram-cylinder, and an adjusting-screw for adjusting the height of the holding-arm above the guide-rest, substantially as set forth.

15. In a phonograph, the combination, with the phonogram-cylinder and the lead-screw, an arm carrying the recorder or reproducer, a guide-arm connected with the carrying-arm, a yielding guide-block engaging with the lead-screw, a guide-rest, and an adjusting-screw for adjusting the height of the carrying-arm upon the guide-rest, substantially as set forth.

16. In a phonograph, the combination, with the swinging arm and the recorder or reproducer carried thereby, of the springy back-rest upon which such carrying-arm is thrown, substantially as set forth.

17. In a phonograph, the combination, with the revolving phonogram-cylinder, of the advancing recorder or reproducer, and the scale for determining the position of the recording or reproducing point upon the phonogram or blank, substantially as set forth.

18. In a phonograph, the combination, with the revolving phonogram-cylinder, and recorder and reproducer mounted upon an advancing holding-arm and adjustable toward and away from the phonogram-cylinder, of a cutting-tool movable with such holding-arm and independently adjustable toward and away from the phonogram-cylinder, whereby the recorder and reproducer can be adjusted out of operative engagement with the phonogram-blank, and the cutting-tool can be adjusted forward into engagement with such blank, substantially as set forth.

19. In a phonograph, the combination, with the revolving phonogram-cylinder and the lead-screw, of the arm carrying the recorder or reproducer, a cutting-tool on such arm for reducing the surface of the phonogram or blank, and a guide-arm engaging the lead-screw and advancing the carrying-arm, substantially as set forth.

20. In a phonograph, the combination, with the revolving phonogram-cylinder, of the swinging arm carrying the recorder or reproducer, a cutting-tool also carried by said arm, a guide-rest, a screw for adjusting the position of the recorder or reproducer and said cutting-tool with relation to the phonogram or blank surface, and a yielding guide-block engaging with the lead-screw and advancing said carrying-arm, substantially as set forth.

21. In a phonograph, the combination, with the cylinder-shaft having a fine screw-thread, the phonogram-cylinder mounted on such shaft, a stationary guide-rod, a sleeve mounted on such guide-rod and capable of sliding and turning movements thereon, a guide-arm secured to said sleeve and having a screw-threaded guide-block engaging the screw-thread, and the holding-arm for the recorder or reproducer, also secured to said sleeve, substantially as set forth.

22. In a phonograph, the combination, with the cylinder-shaft having a fine screw-thread, the phonogram-cylinder mounted on such shaft, a stationary guide-rod, a sleeve mounted on such guide-rod and capable of sliding and turning movements thereon, a guide-arm secured to said sleeve and having a screw-threaded guide-block engaging the screw-thread, the holding-arm for the recorder or re-

producer, also secured to said sleeve, and a guide-rest for determining the rotary position of the guide-sleeve, substantially as set forth.

23. In a phonograph, the combination, with the cylinder-shaft having a fine screw-thread, the phonogram-cylinder mounted on such shaft, a guide-rod and sleeve, a guide-arm secured to said sleeve and having a screw-threaded yielding guide-block engaging the screw-thread, the holding-arm for the recorder or reproducer, also secured to said sleeve, and a guide-rest for determining the rotary position of the guide-sleeve, substantially as set forth.

24. In a phonograph, the phonogram-cylinder tapering throughout its length, substantially as set forth.

25. In a phonograph, the combination, with the cylinder-shaft mounted in bearings and projecting at one end beyond such bearings, of a smooth surface phonogram-cylinder tapering throughout its length and carried by the shaft outside of its bearings, substantially as set forth.

26. In a phonograph, the combination, with a tapering phonogram-cylinder, of two or more phonogram-blanks of different lengths having tapering bores adapted to fit said phonogram-cylinder and provided with cylindrical recording-surfaces, substantially as set forth.

27. In a phonograph, the combination, with a tapering phonogram-cylinder, of a phonogram having a tapering bore and a cylindrical outer surface held upon said cylinder by friction, substantially as set forth.

28. In a phonograph, the combination, with a holding-frame, of the recording and reproducing devices constructed each as a complete self-contained body removably attached to said holding-frame, substantially as set forth.

This specification signed and witnessed this 22d day of November, 1887.

THOS. A. EDISON.

Witnesses:
WILLIAM PELZER,
E. C. ROWLAND.